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8-314

Wesmont Terminal Navigation Beacon, Model 4

The Wesmont Model 4 Beacon is a low-power transmitter designed to function with standard homing equipment common to all types of military aircraft. No special airborne equipment is required in conjunction with its use. Sets presently in existence operate in the frequenct range just above the standard broadcast band (1600 to 1700 kilocycles).

The Model 4 is of miniaturized design incorporating a transmitter 5" x 7" x 2½" along with a mating power-pack 3" x 7" x 2½". The total weight of the entire unit including antenna and related accessories is less than 20 pounds.

In operation the beacon does not require the services of a trained radio operator. Anyone can be taught to set up and operate the device in a single 15-minute briefing.

The Model 4 has been adapted to provide for keying or triggering from the homing aircraft. An airborne transmitter designed to work with standard aircraft electrical and antenna systems has been developed for that purpose. Thus, the Model 4 (Wespondor) may be operated either manually on the ground or set up on "stand-by" for activation at any time by the homing aircraft.

Present design of the Model 4 power source incorporates the use of ten type RM-42-R Mallory Mercury Cells. Input is rated at 9.6 watts.

Antenna

The antenna is a telescoping whip type incorporating three sections each of which telescopes to less than twenty inches. The design of the antenna is such as to provide for a low angle of radiation, thus allowing maximum possible low level (under 500 ft.) as well as higher altitude homing. The nature of the signal transmitted is omnidirectional. It may also be described as contoured. That is, it tends to follow surface contour to the limit of its range. A loading coil is employed to provide proper electrical lengths.

When erected, the antenna, complete with loading coil, stands approximately 29 feet.

Wesmont Terminal Navigation Beacon, Model 10

As to size and configuration, the Model 10 Beacon is essentially the same as the Model 4 with the exception of the power source. The power source employed is a standard 12-volt wet cell battery with an input of approximately 18 watts. Operational characteristics, with the exception of added range resulting from the larger power input, are the same as the Model 4. The same antenna is employed.

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Operational Characteristics

I Calculated range (statute miles) at 500 feet altitude.

Conductivity* -	.5	1	2	4	8	15
Model 4 -	7.8	8.8	10.7	14.5	21.5	31
Model 10 -	10.5	12	14	19	28	39

*See attached FCC map setting forth conductivity values for U. S.

Factors which may affect performance:

1. FCC Conductivity Map shows average values in a given area. Actual value may vary slightly within the given area.
2. Figures based on use of ADF having sensetivity of 5 microvolts.
3. Weak batteries will tend to shorten range.
4. Poor ground connection will shorten range.
5. If transmitter not properly tuned will tend to shorten range.

II Accuracy

Both models 4 and 10 provide for a high degree of azimuth and pinpoint indication. In every instance the aircraft is brought in directly over the beacon. A narrow cone of silence provides for a rapid 180° swing of the compass. Depending on altitude and sensetivity of airborne homing equipment the swing of the compass is effected in from 1 to 5 seconds.

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TRIGONOMETRIC CALCULATION METHODS

A. Radio Loop Determination of Elevation Angle

Requirements:

1. An exterior horizontally mounted ADF loop connected to a receiver and null detector.

2. Vertical sensor for reference during airframe pitch movement.

3. Accurate information of the beacon altitude or barometric information telemetered from the beacon.

4. Simple computer to solve the $\tan \emptyset = \frac{a}{d}$ problem.

5. Distance read out device.

Problem Areas:

1. Making accurate small angle measurements.

2. Obtaining accurate, stable, vertical reference.

3. Obtaining accurate differential altitude.

With this system the probable maximum accuracy can be estimated from Fig. I, if assumption is made of the angular resolution of the loop and altitude differential error.

Assuming an accuracy including vertical reference error (probably about 10 minutes of arc) of plus/minus 1° and altitude information of plus/minus 2%, the distance error at one nautical mile at 200 ft. elevation would be approximately plus/minus .6 N. mile. At 500 ft. elevation at one mile, the error would be approximately plus/minus 0.2 N. mile. This system would be expected to be very accurate in the above conditions at distances less than 0.2 N. mile.

Proposed Areas of Study:

1. Maximum obtainable loop resolution accuracy under conditions dictated by this problem, i.e. mounted on an airframe close to the ground.

2. Determine the effects of ground reflection on accuracy.

3. Determine parameters for the receiver and computer, such as gain, output, etc.

4. Investigate methods of simple barometric sensing and translation for transmission to the aircraft with minimum equipment and of proper size and weight.

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5. Evaluate the various methods of read out for best method for this device.

B. ADF Determination of Angle between Two Beacons

Requirements:

1. ADF installation with provisions for dual frequency operation, either switched or simultaneous.
2. Predetermined approach course.
3. Predetermined beacon spacing.
4. Correction for slant range.
5. Simple computer.

Problem Areas:

1. Difficulty in making predetermined course approach due to terrain, etc.
2. Making small angular measurements that are required at distances over a few hundred feet.

With this system the loop resolution and the layout of the beacons on the groundwould determine the major areas required for accuracy; otherwise, the same general conditions would prevail as for the elevation angle method. These are both best suited for distances under approximately one N. mile.

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REAL TIME R. F. TRANSMISSION MEASUREMENT

Requirements:

1. High speed switching of a transmitter and receiver at both the airborne and beacon locations.
2. Device to measure accurately the interval between transmission and reception of signals in the aircraft.
3. Slant range correction.

Problem Areas:

1. Pulse rise time limits at present operating frequency.
2. Band width requirement at operating frequency. Delta f $= \frac{1}{T}$
3. Accuracy decreases very rapidly as distance measured falls below approximately 5 miles due to the very short interval required to be measured compared to the delays present in the receiver transmitter combinations.
4. Random noise at present operating frequency, particularly during nighttime.

Since the round trip time required for one N. mile is 12.37 microseconds, it can be seen that to measure distances accurately in this region the system must respond to changes of 1.237 microseconds to give .1 mile increments and, conversely, a delay in the system of this amount will give an equivalent error. The current aircraft DME equipment, operating at 900 - 1215 mc. under good conditions, attains this order of accuracy; however, it can be seen that a system operating in the one to two mc. region the rise time and system delays would be in the order of 10 to 15 microseconds or about plus/minus 1 mile.

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5 MICROVOLT RECEIVER SENSITIVITY

Transmitter Power	.5	1	2	4	8	15	Ground Conductivity
4 Watts	7.8	8.8	10.7	14.5	21.5	31	
16 Watts	10.5	12	14	19	28	39	

Mileages indicated are for elevation of approximately 500 feet but can be considerably less if batteries are weak, poor ground connection, or transmitter improperly tuned.

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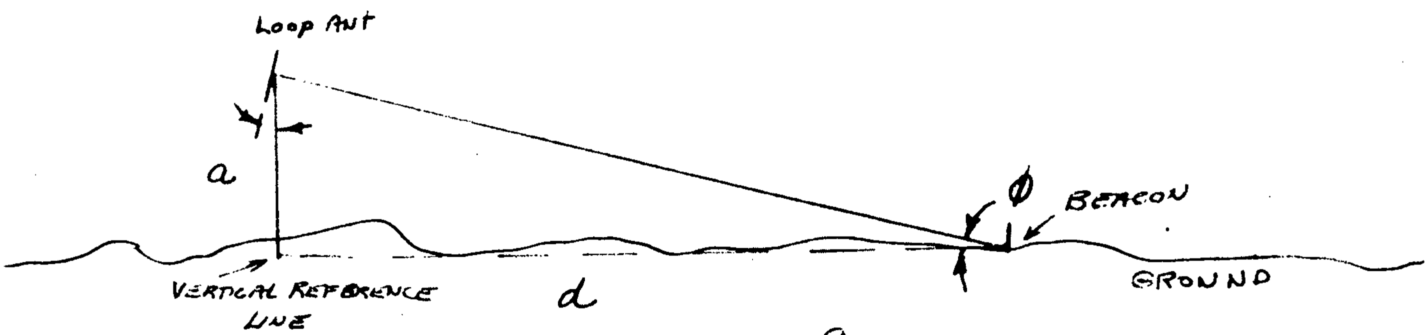
TRIGONOMETRIC METHODS

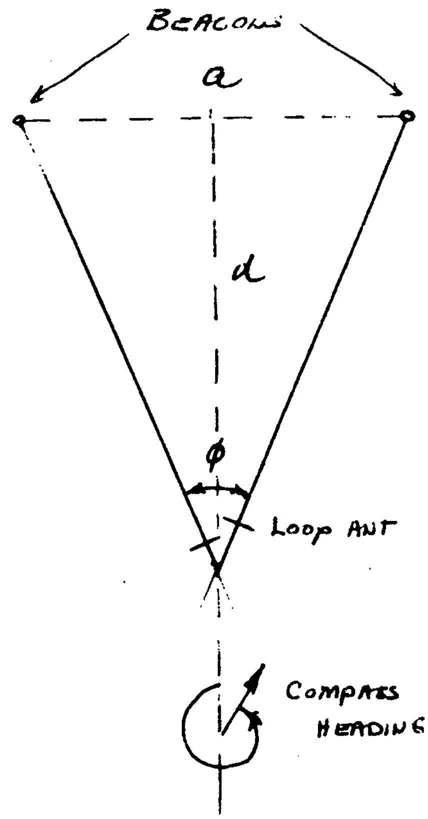
FIG 2.

A



$$d = \frac{a}{\tan \phi}$$

B.



$d =$

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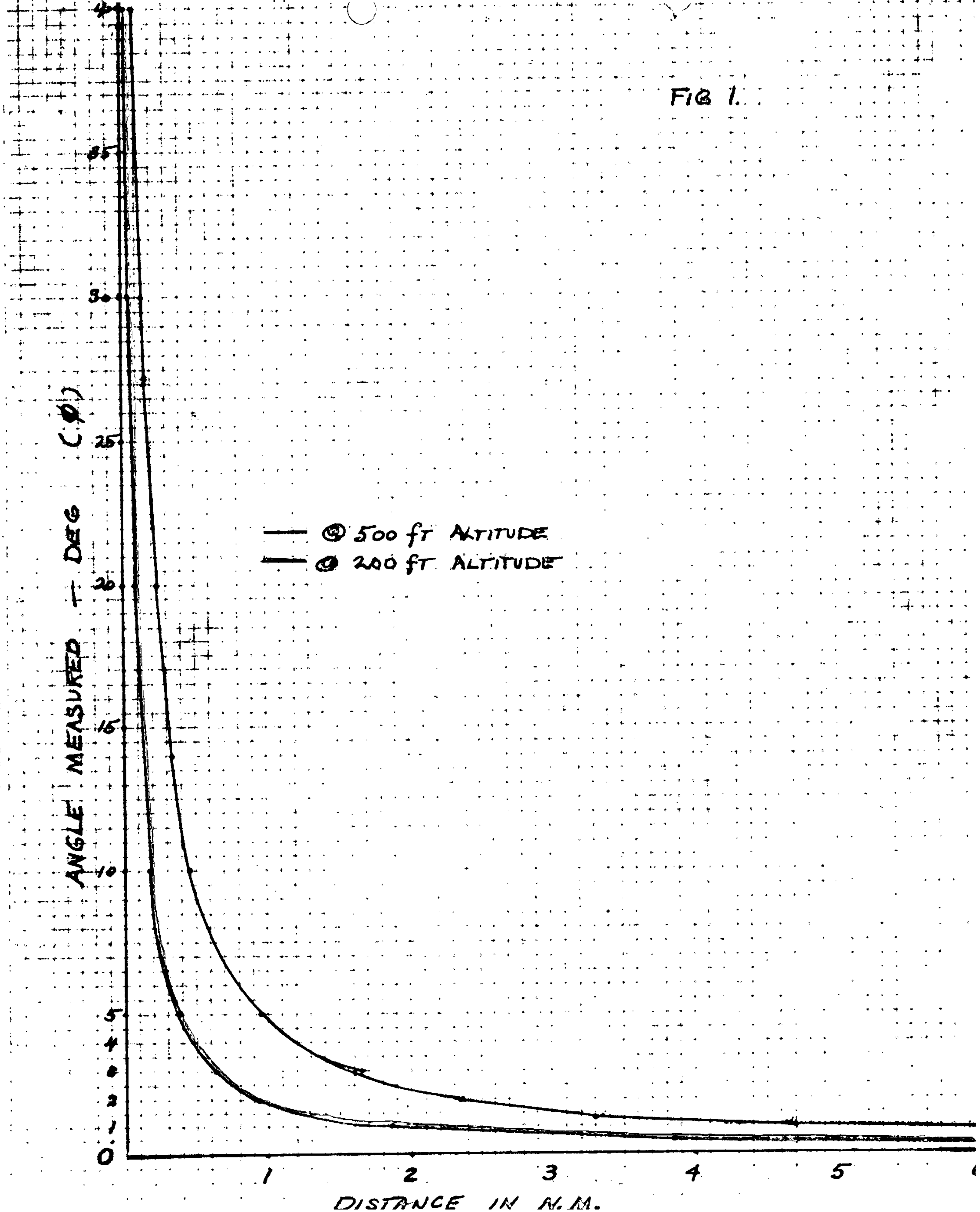

FIG 1.

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